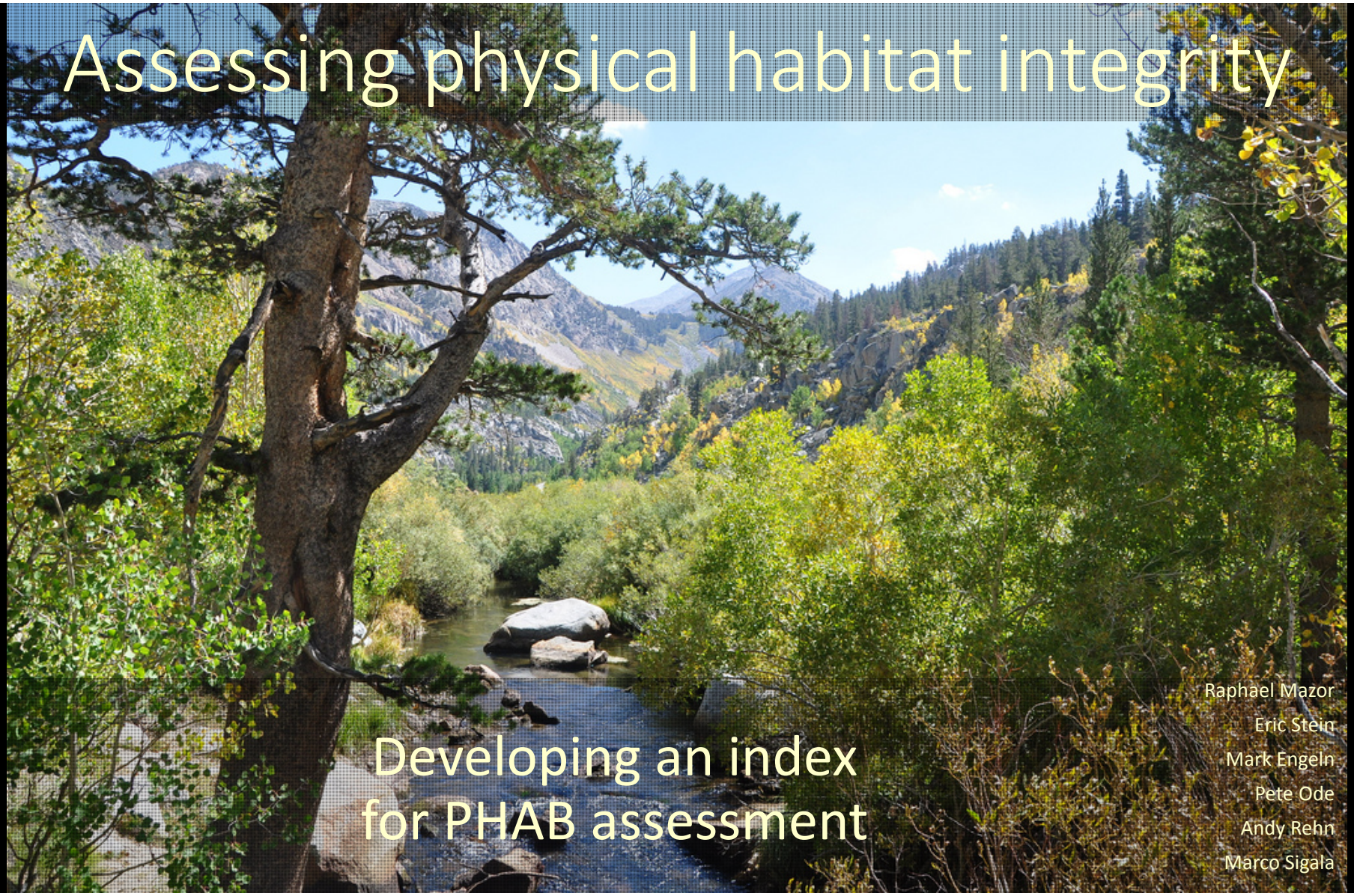
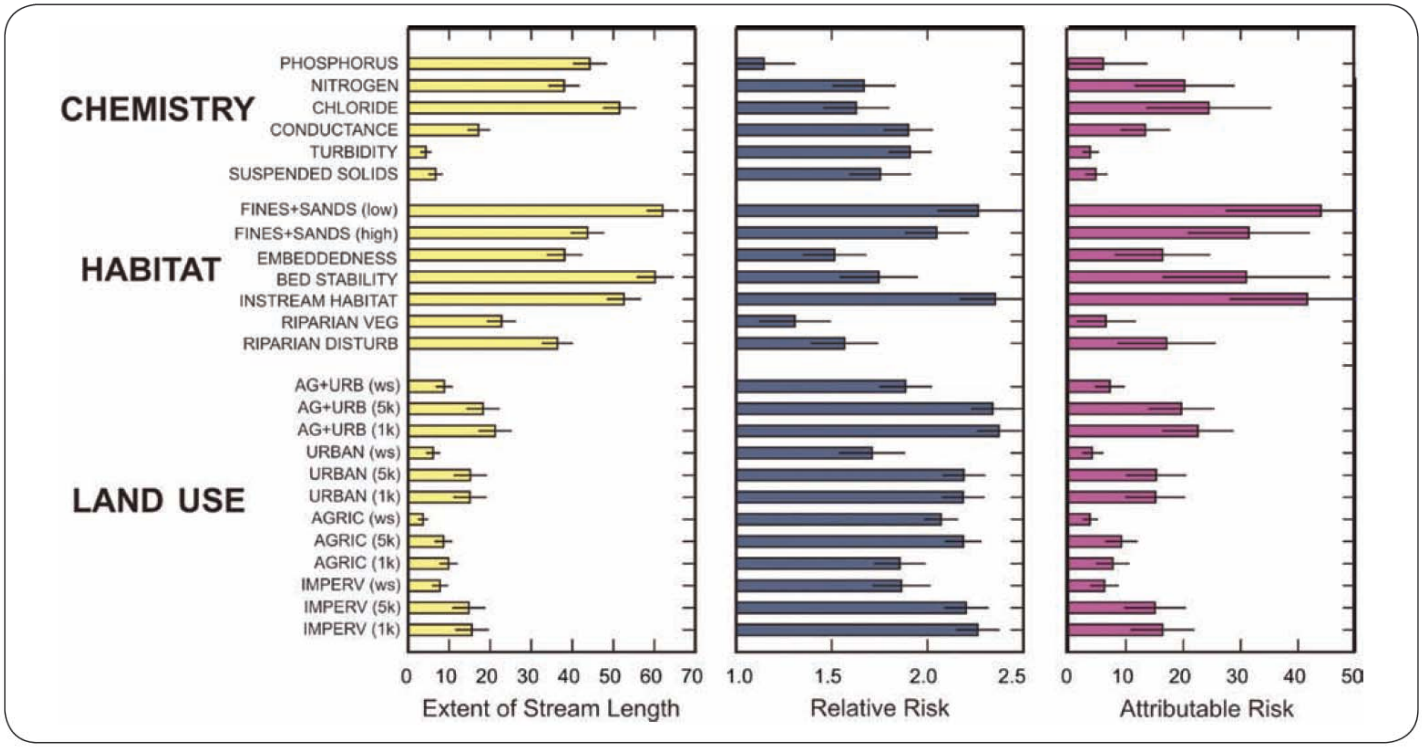
Assessing physical habitat integrity



Developing an index for PHAB assessment

Raphael Mazor
Eric Stein
Mark Engeln
Pete Ode
Andy Rehn
Marco Sigala

Why assess habitat quality?

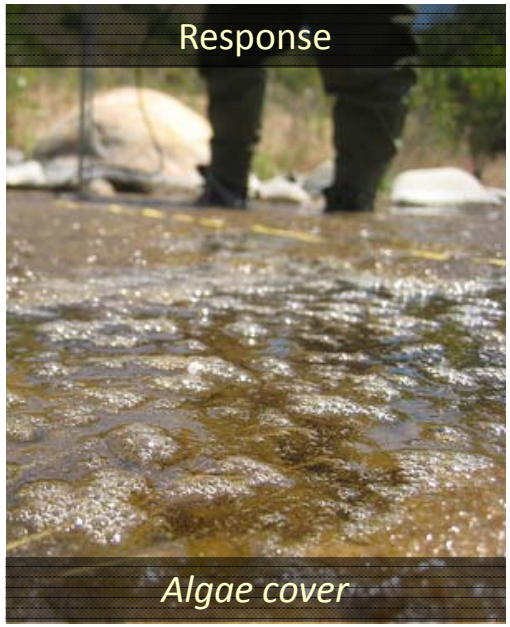


A top stressor for streams in California

Referenced in many 303(d) listings

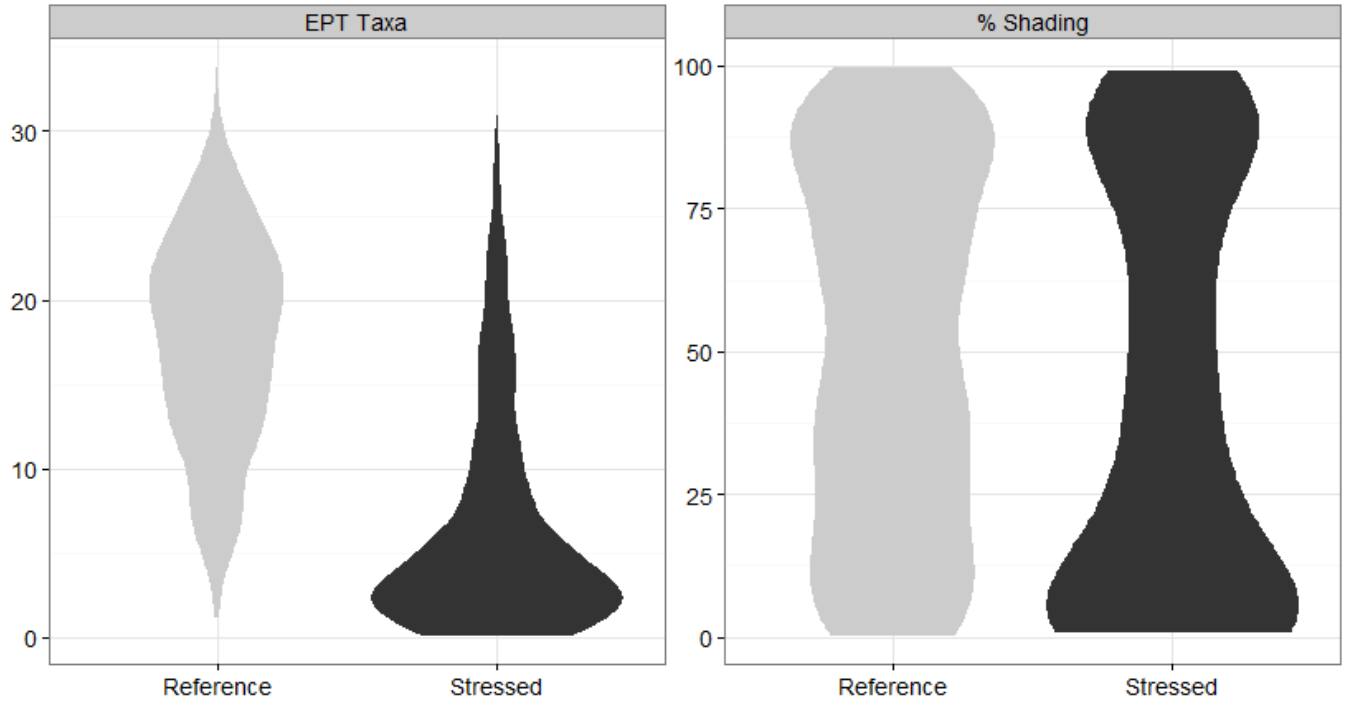
PHAB metrics are not like biological metrics

- Bio-metrics are a response to stress.
- PHAB metrics may be a measure of stress, a response to stress, both, or neither (yet still important for biology).



PHAB metrics are not like biological metrics

- PHAB metrics often cover the full range of values in both reference and stressed sites.



PHAB metrics are not like biological metrics

Sediment deficiency

- Bio metrics usually respond in one direction (e.g., increasing or decreasing metrics).
- PHAB metrics may respond in one or two directions, depending on the site and/or stressor.

Sediment excess

PHAB metrics are not like biological metrics

- PHAB metrics often respond to stress independently.
- Bio metrics typically integrate stressors.

What are the challenges?

Challenge	How to solve it
1. Identifying meaningful metrics	Develop a conceptual model
2. Setting appropriate expectations	Develop statistical models based on reference condition
3. Selecting useful metrics	Screen metrics based on objective performance criteria (e.g., accuracy, precision, responsiveness)
4. Combining metrics into an index	Lots of options (all of them optional!)

Some steps are similar to biological index development, but differences are important!

PHAB Conceptual Framework

Identify thematic areas.

Evaluate potential for response.

Thematic area	Example metric
Channel morphology	Bank H:W ratio
Instream habitat-flow	% Fast water
Instream habitat-patch types	Natural habitat cover
Instream habitat-substrate	% sands and fines
Riparian complexity	% canopy presence
Energy	% algae cover

Setting expectations

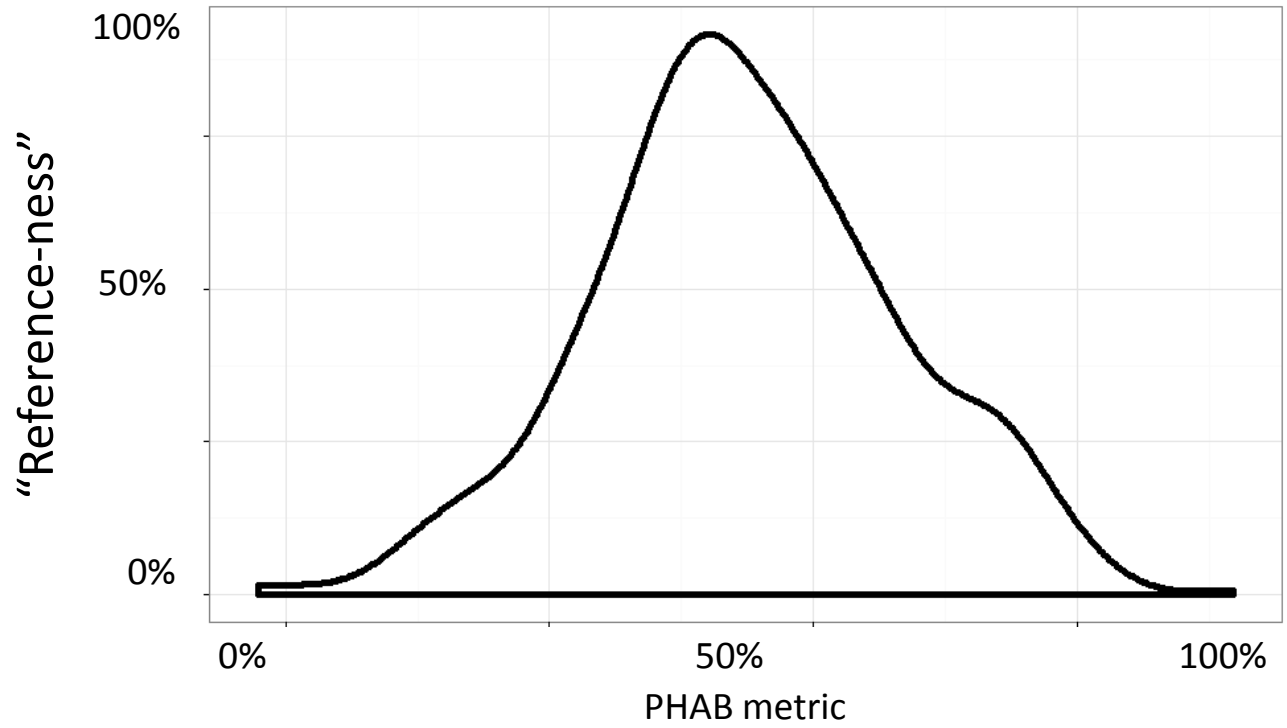
What metric values do you see at ref sites in similar environmental settings?

Use similar (reference condition) approach as bio-objectives, but allow for more flexibility in how metrics respond to stress differently at different sites.

Setting expectations

What metric values do you see at ref sites in similar environmental settings?

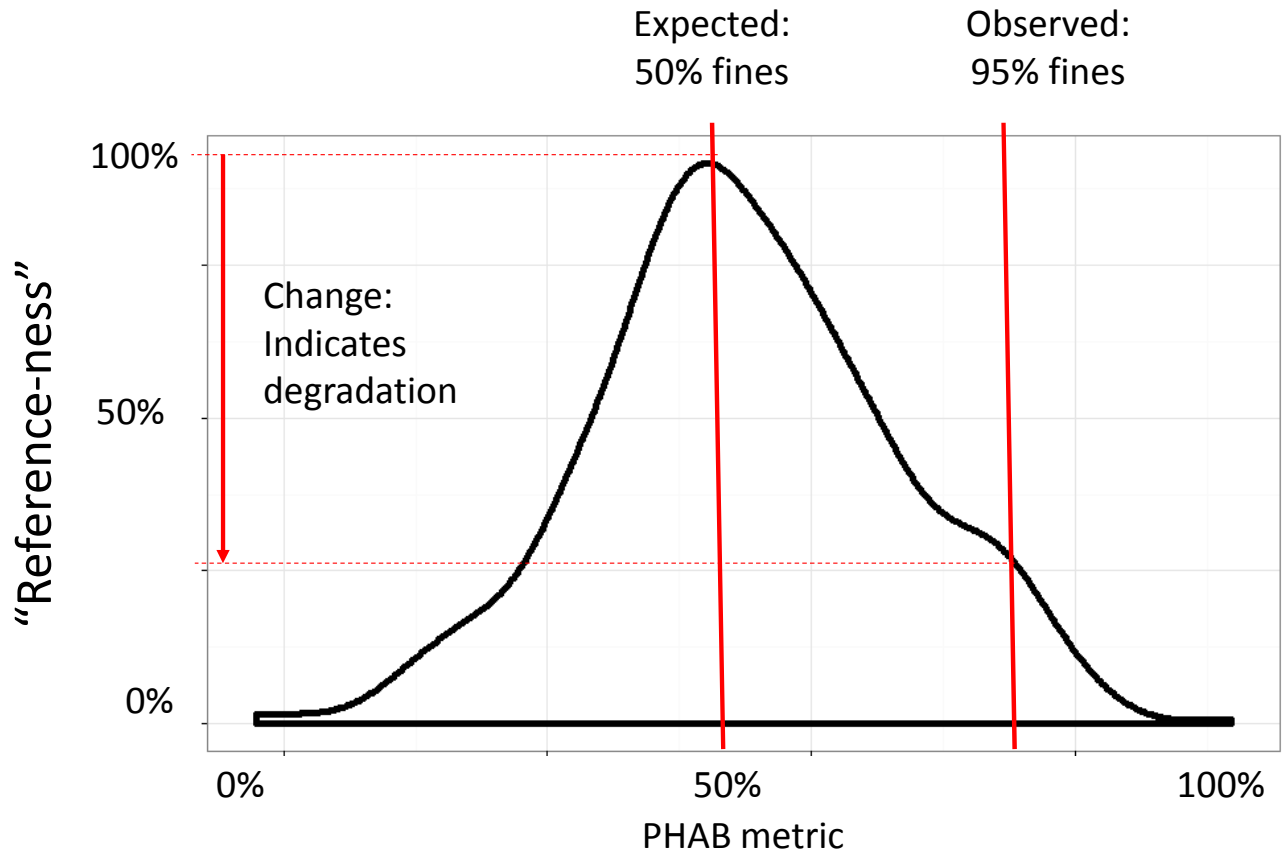
In a given setting, what range of metric values are expected under reference condition?



Setting expectations

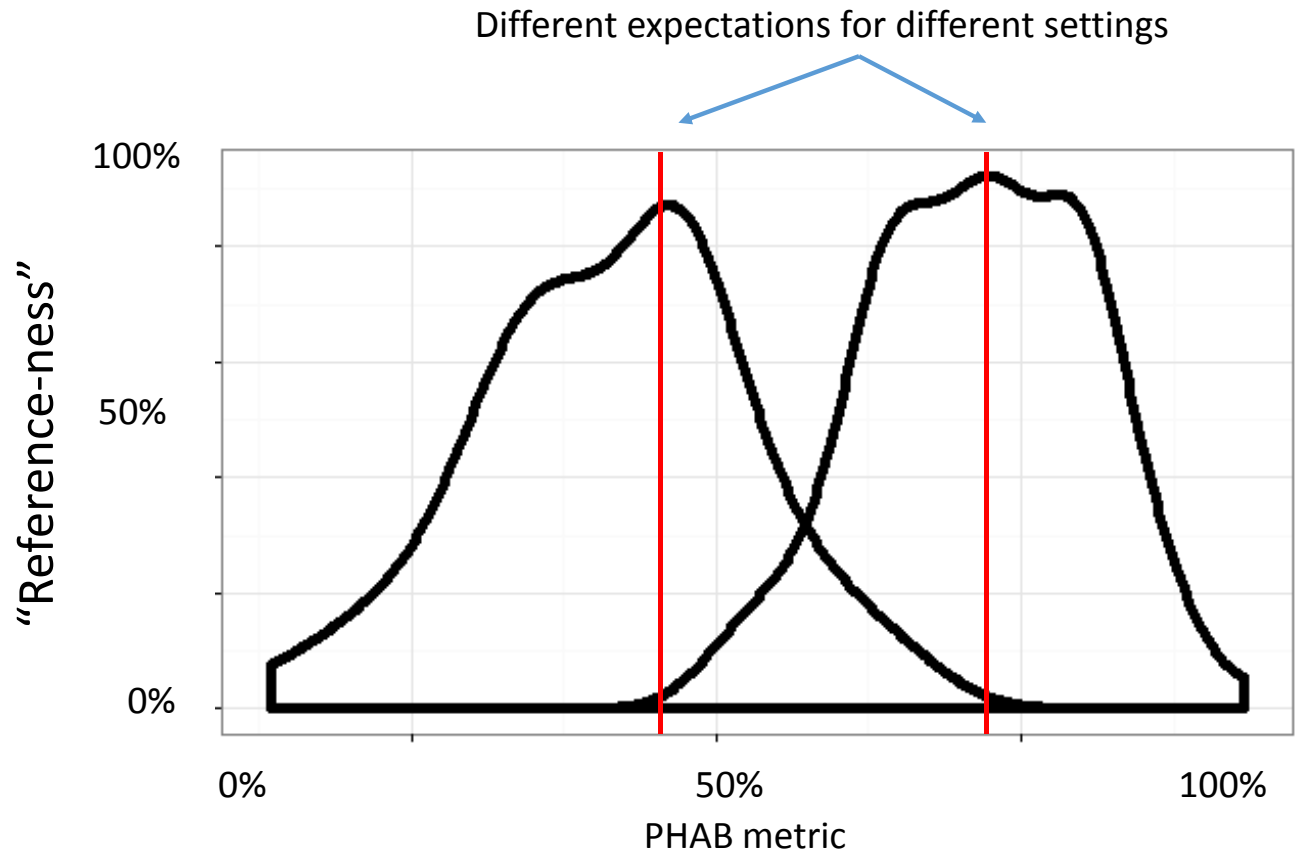
What metric values do you see at ref sites in similar environmental settings?

Responses could be unidirectional, bidirectional, and even asymetric.



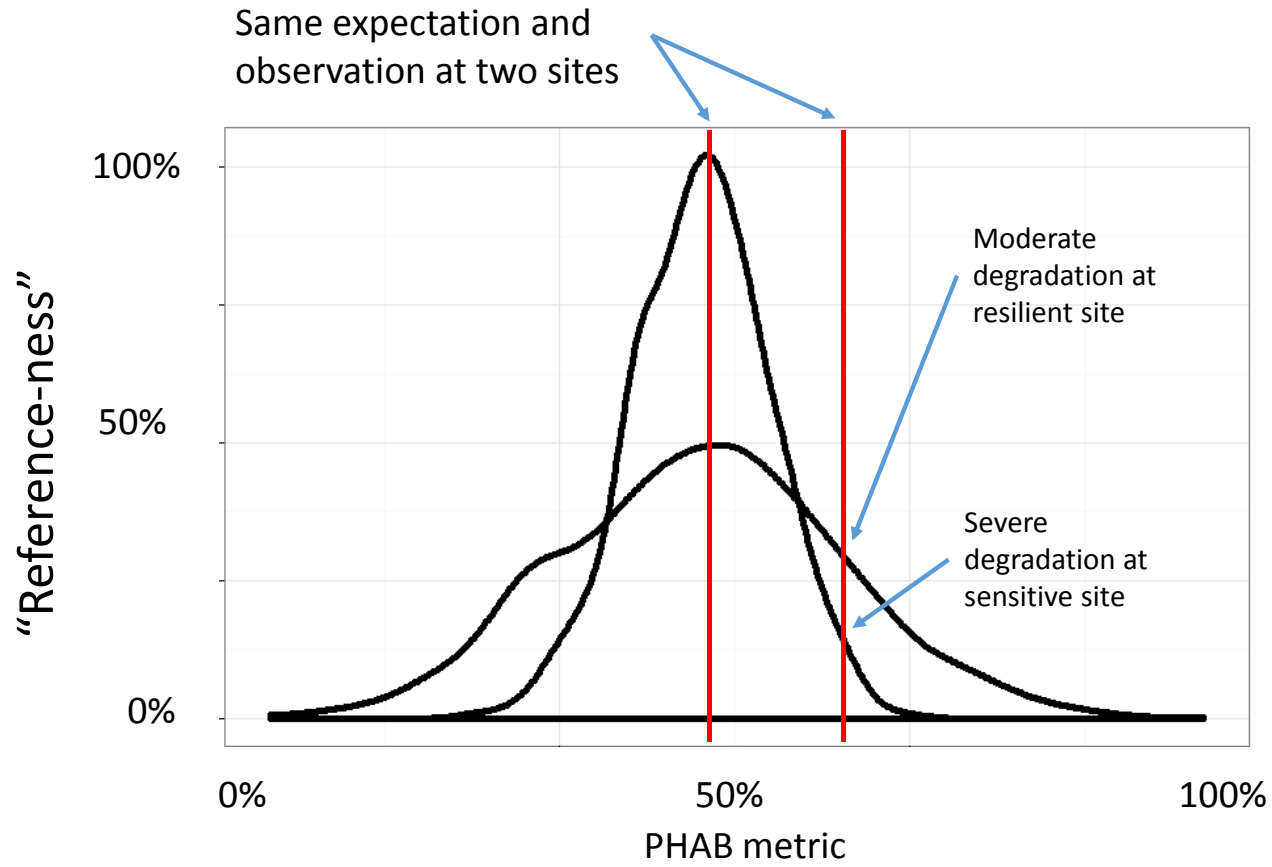
Setting expectations

What metric values do you see at ref sites in similar environmental settings?



Setting expectations

Each setting has its own expectation AND response:

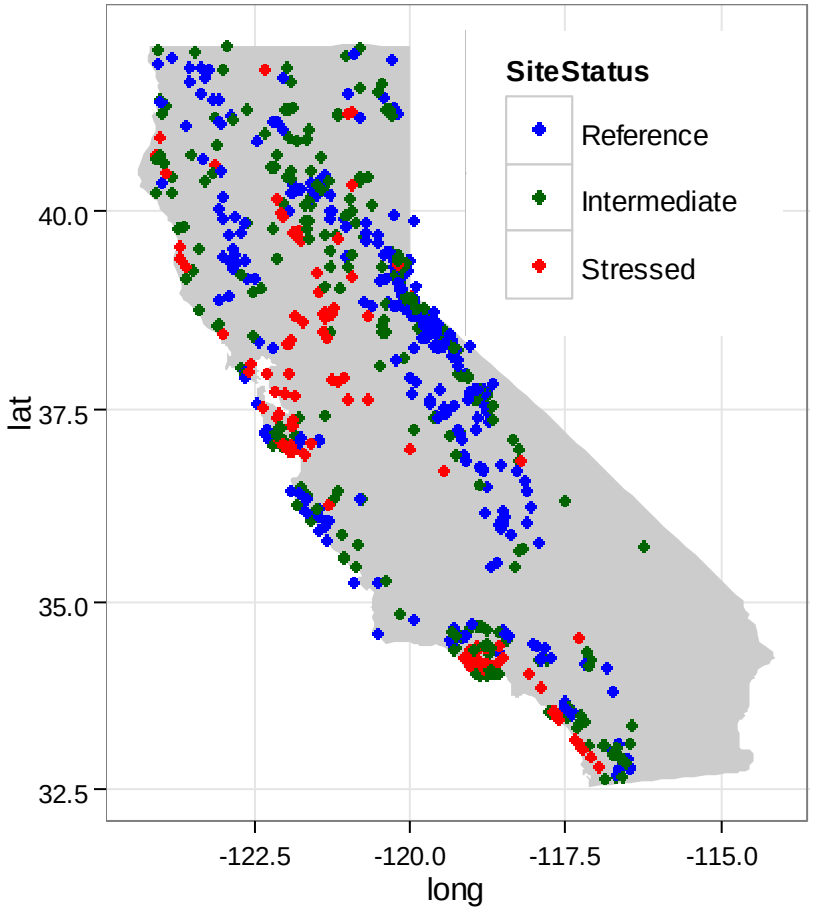


Defining environmental setting

Location	Catchment morphology	Long-term climate	Soils	Minerology
Latitude	Watershed area	Catchment precipitation	Hydraulic conductance	MgO content
Longitude	Elevation range	Local precipitation	Bulk density	CaO content
Elevation	Aspect	Local temp	Erodibility	S content
			Permeability	N content
				P content

Possibly use field-measured factors (e.g., slope) as well?

Technical challenge: Need lots of reference data



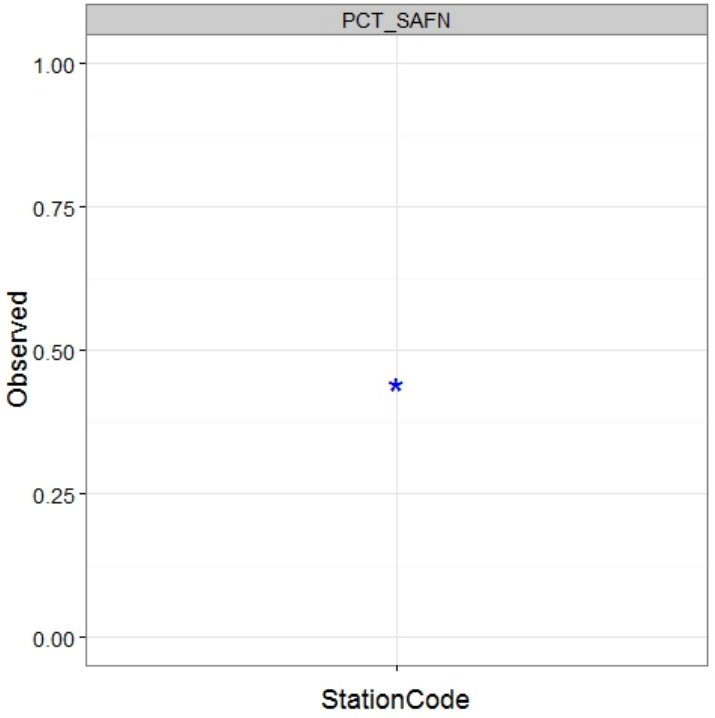
Site type	N
Reference	352
Intermediate	292
Stressed	132

Much less data currently available than for BMI scoring tool

(We haven't used these protocols as long or as widely)

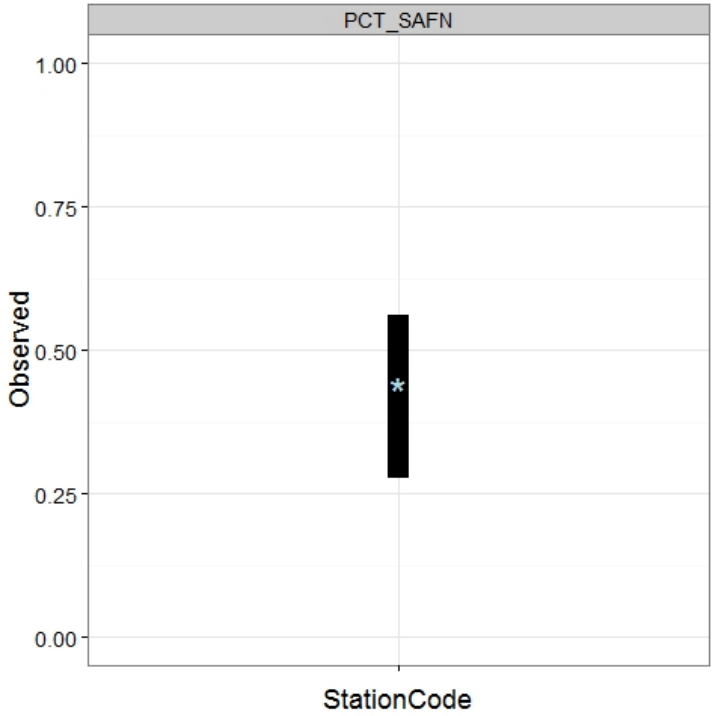
Example with real data

Wilson Creek
Tijuana Watershed



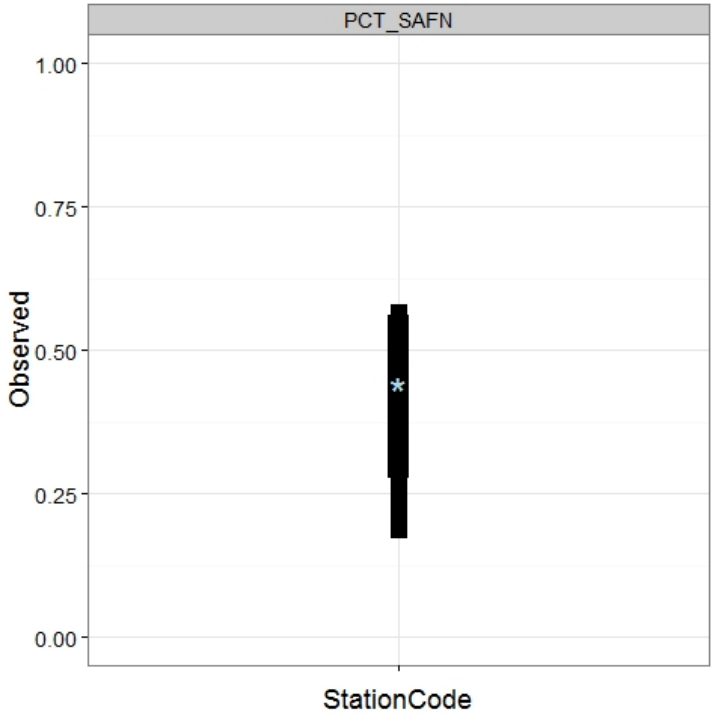
Median expectation:
44% sands and fines

Example with real data



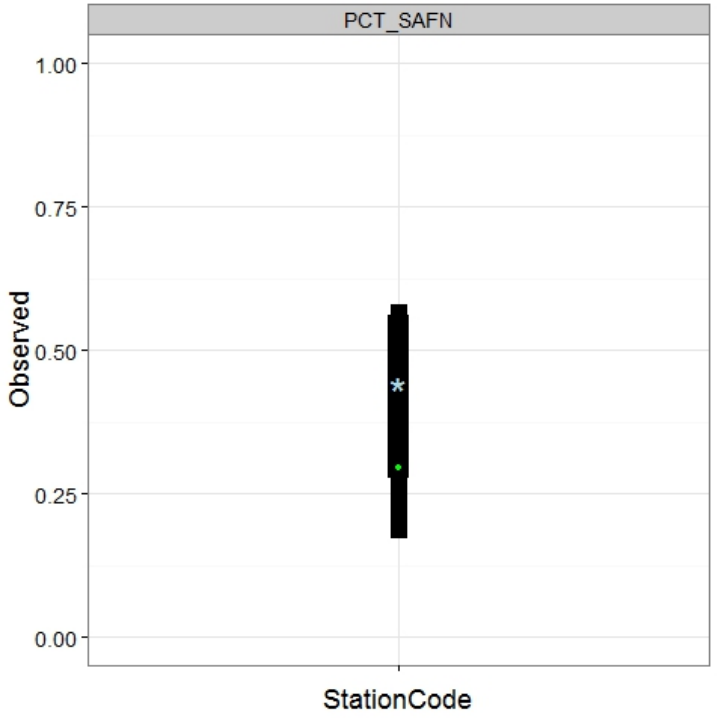
"Good" range (25th to 75th percentiles)
28 to 56% sands and fines

Example with real data



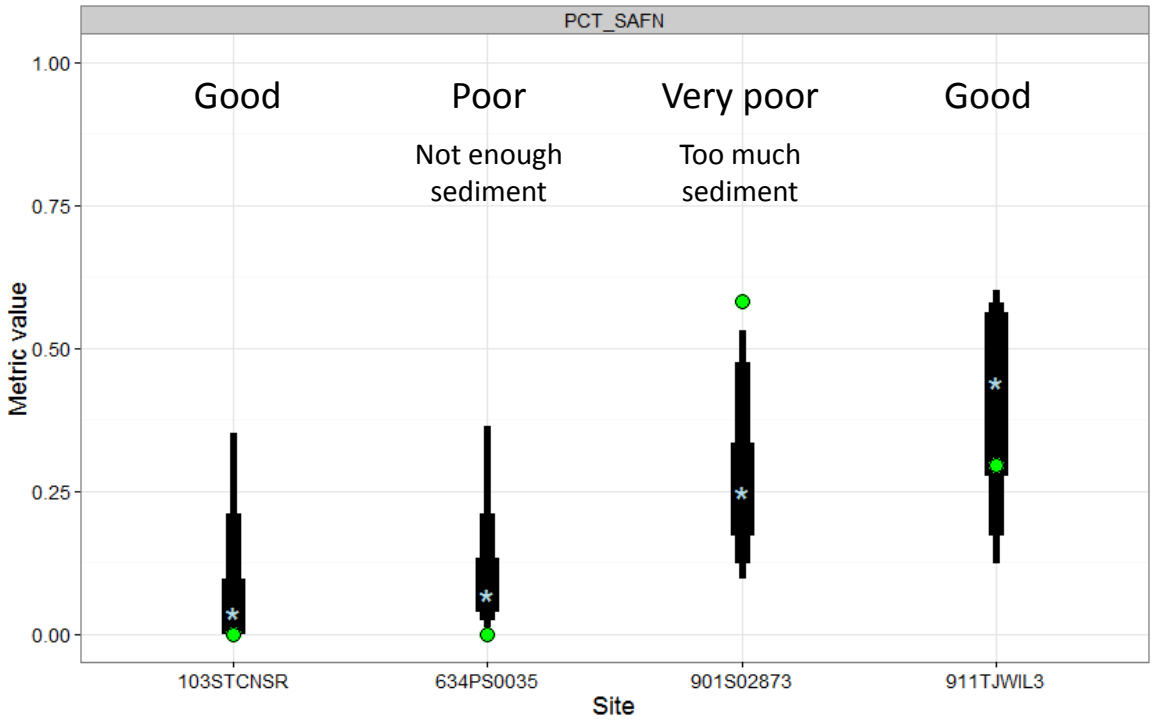
"Fair" range (10th to 90th percentiles)
17 to 58% sands and fines

Example with real data



Observed: 30%
Within “good” range

Site specific expectations, scoring



Evaluating metrics

Similar framework as bio-objectives:

Accuracy

- Unbiased predictions at reference sites

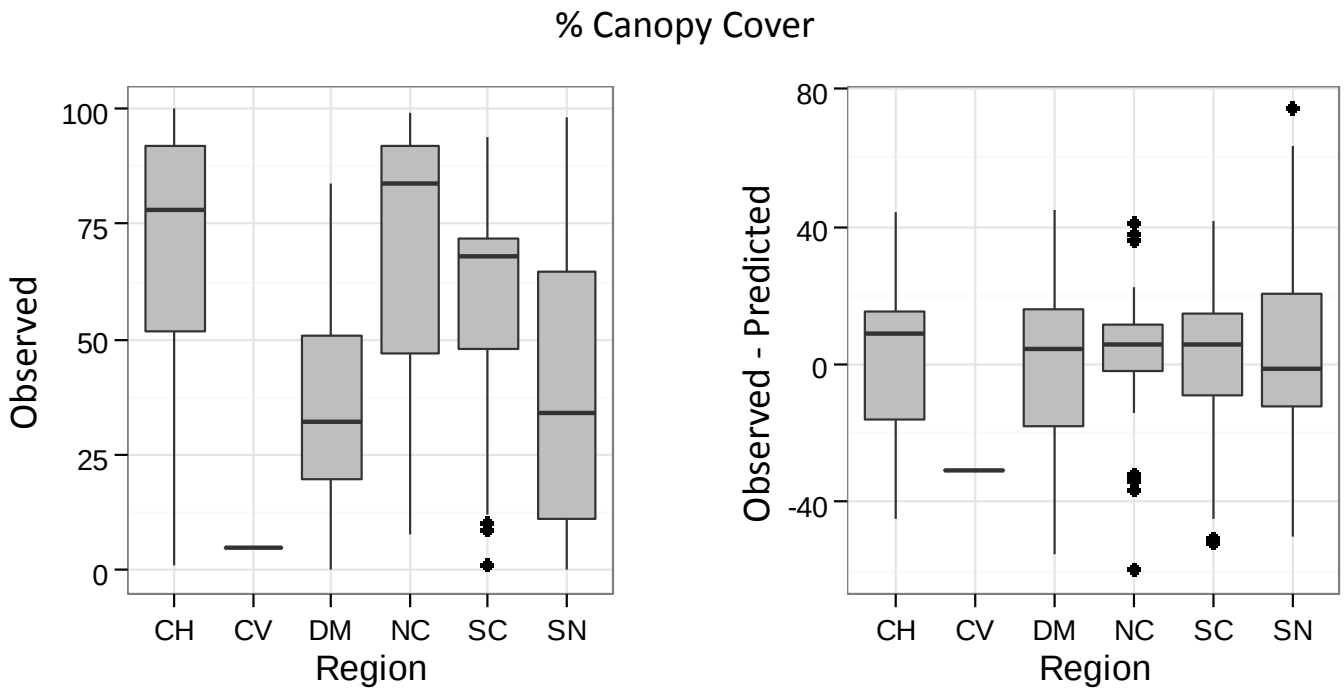
Precision

- Small prediction errors
- Low variability among replicate samples

Sensitivity

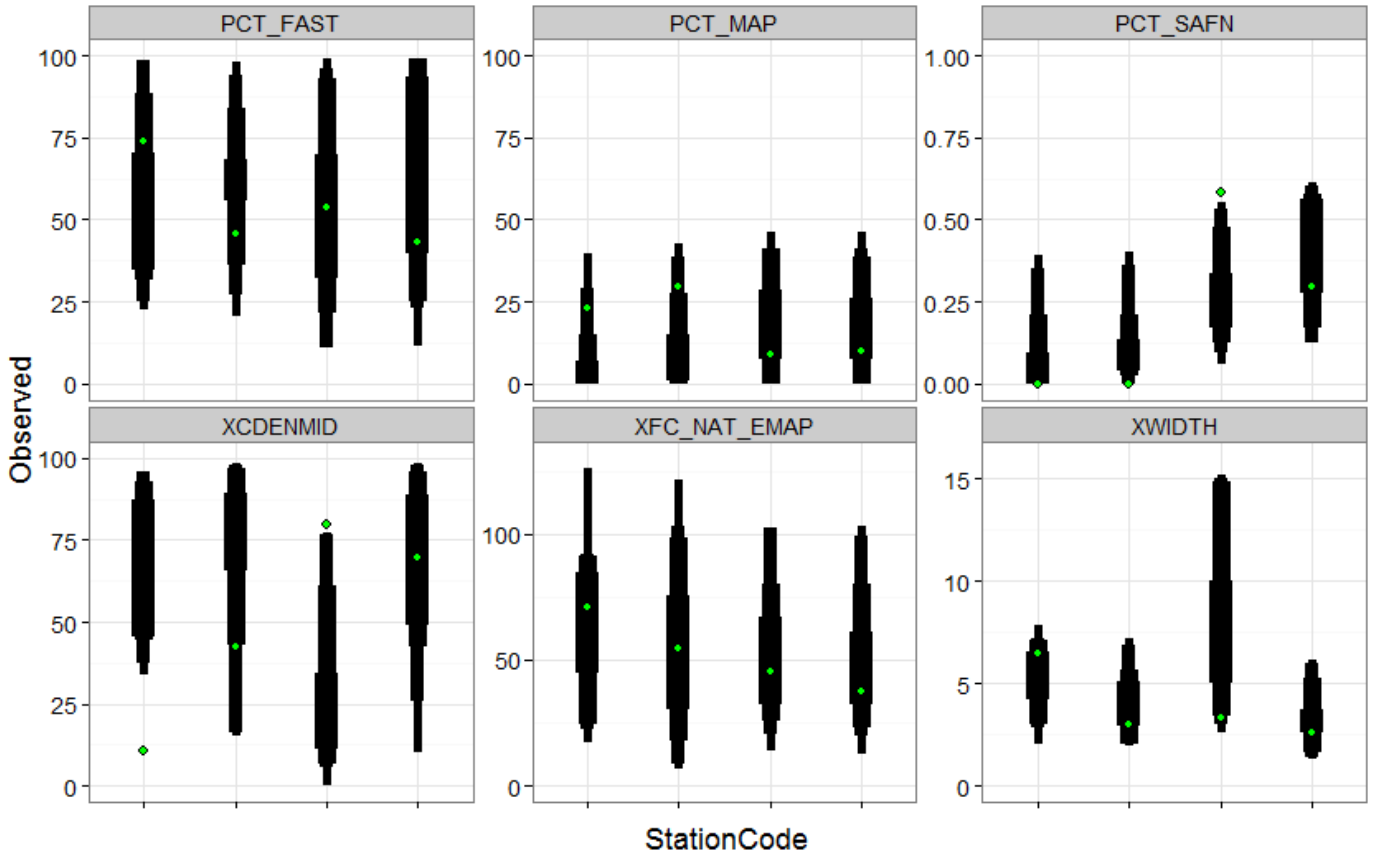
- Good discrimination between reference and stressed sites
- Expected response to stress

Evaluating bias



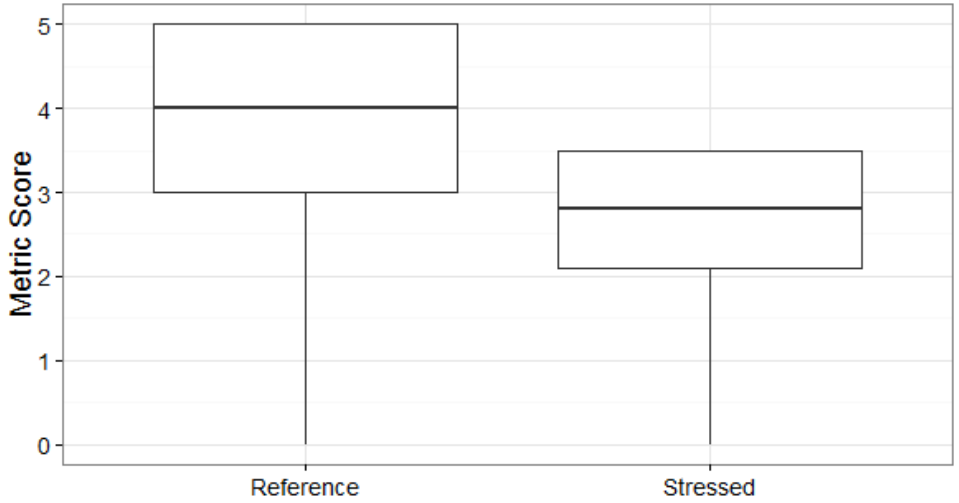
Reduced bias by region

Evaluating precision



Evaluating sensitivity: Not straightforward!

- Complex responsiveness of PHAB metrics: Can't assume PHAB metric has responded at every "stressed" site.



Combining PHAB metrics into an MMI

- PHAB metrics may be useful independently.
  - A single metric can be used to evaluate specific aspects of habitat condition.
- Many approaches to combining metrics:
  - Holistic: Integrate many different aspects of habitat condition in one index.
  - Thematic: Index focused on single aspect of habitat condition (e.g., in-stream habitat, riparian condition, primary productivity, etc.).
  - Performance-based: Select metrics based on their ability to provide a clear signal of stress.
  - Stressor-specific: Select metrics known to respond to specific stressors (e.g., grazing, hydromod)
  - Biologically oriented: Select metrics based on their influence on biological indices

What's next?

- More reference data needed
- Validation at sites with known impacts
- Exploring different approaches to MMI assemblage


Questions?
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Thanks to Matt Cover, Dave Herbst, Revital Katznelson, Betty Fetscher, the Stormwater Monitoring Coalition